

The last of the Ediacara Biota at Mt. Dunfee, Nevada

Project Report

Introduction

The Lewis and Clark Fund not only allowed me to test the hypothesis that an abiotic stressor dealt the final blow to the Ediacaran biota, but also to collect preliminary data that has helped launch a multiyear ongoing project and multiple collaborations as I am starting a faculty position at Johns Hopkins University. Using these funds, I discovered many new Ediacaran fossils at Mt. Dunfee as well as other localities (see Smith et al., 2017). What started out as a local study of Mt. Dunfee, has turned into a major research initiative on the Ediacaran-Cambrian boundary across California and Nevada (Smith and Nelson, in prep). This work has helped to establish several ongoing collaborations and has generated much interest within the USA as well as internationally, as evidenced by the number of invited talks given across the country and internationally, and by the request of the Ediacaran Subcommittee for me to lead a field trip to the Ediacaran fossil localities in Nevada during Spring, 2018. Specific scientific results, ongoing collaborations, and publications and conference proceedings are detailed in the sections below.

Scientific Results and Significance

There are several different interesting results and new discoveries that have directly resulted from this funding. The biggest discovery is that there are well-preserved diverse Ediacaran fossils in the Montgomery Mountains, another locality in Nevada. These new fossils are important because they include erniettomorphs, an example of a more “classic” Ediacara biota, and a variety of tubular organisms similar to some described from Mt. Dunfee. These finds were important for two reasons: 1) because they demonstrated that two very different groups of organisms were ecologically and stratigraphically overlapping at the end of the Ediacaran and 2) both Ediacaran erniettomorphs and tubular fossils are found below and within the onset of the large basal Cambrian $\delta^{13}\text{C}$ excursion, demonstrating that, similar to the fossils at Mt. Dunfee, their disappearance in the fossil record is synchronous with an environmental perturbation to surface waters. These results were published in Smith et al., 2017.

The fossil discoveries in the Montgomery Mountains raised the possibility that there are more Ediacaran fossils preserved in the late Ediacaran strata that are extensively preserved across CA and NV. Part of the funds in this grant were used to collect preliminary data on other sections across the Ediacaran-Cambrian basin. Ediacaran body fossils have been in at least six different sections across the southwest USA, and we are working on refining the intra-formational correlations, and paleoenvironmental and taphonomic contexts for these fossils. This is ongoing work, and results should be published by the end of 2018.

Additionally, Ediacaran microfossils have been recovered at several stratigraphic horizons at Mt. Dunfee. Many of these fossils are preserved as carbonaceous compressions, and an undergraduate student at Johns Hopkins University is working on imaging and describing these new fossils. This project is ongoing, but we expect that the results will be submitted for publication by the end of 2018.

International interest and collaborations established as part of this project

This work has resulted in much interest from paleontologists and geologists in the US as well as internationally. One notable indication of this interest is that the Ediacaran Subcommittee has asked me to lead a week-long field trip to Mt. Dunfee and other areas in Nevada during Spring, 2018. This trip will include researchers from China, Russia, Canada, USA, Brazil, and Germany, and is part of an international effort to place a GSSP for the last subdivision of the Ediacaran Period.

Additionally, samples that were collected during my field work funded by APS spawned on-going collaborations that are in various stages with a number of paleontologists. I anticipate that all of these on-

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going projects will result in presentations and publications. Some of these on-going projects include detailed taphonomic and taxonomic work on the pyritized tubular fossils from three sites in Nevada and California (with J. Schiffbauer at Univ. of Missouri), documentation of the trace fossils across the Ediacaran-Cambrian boundary from these sections (with S. Darroch at Vanderbilt and L. Tarhan at Yale), taxonomy of biomineralizing tubular fossils from Mt. Dunfee (with J. Schiffbauer at Univ. of Missouri and B. Yang at Institute of Geology, Beijing).

Outreach

The results of this work have also been presented to the general public in two forms: 1) a soon-to-be published *Eos* article on the new Nevada Ediacaran fossils published in Smith et al., 2016; 2017; and 2) hands-on presentations to the general public at the Smithsonian National Museum of Natural History for “The Scientist is In!”.

Publications, Conference Presentations, and Invited talks

Data and material that were generated with the financial support from the grant have already yielded many tangible results that include: one publication, at least three publications in preparation, six conference presentations (two invited), and six invited departmental seminars. These are all listed below, and copies of all future publications resulting from this work will be sent to the APS Library.

Publications that have resulted from this work (student author indicated with *)

- Smith, E.F.**, Nelson, L.L.*, Zeng, H., Tweedt, S.M. Workman, J.B., 2017. A cosmopolitan late Ediacaran (~550-541 Ma) fossil assemblage: New fossils from Nevada and Namibia provide link between latest Ediacaran assemblages globally: *in review, Proc. of the Royal Society of London B*.
- Tweedt, S.M., **Smith, E.F.**, Janussen, D., Darroch, S.A., Erwin, D.H. Sponge biofabrics from the late Ediacaran of Namibia and Southwest United States: *in review, Geology*.
- Smith, E.F.**, Nelson, L.L.*. The basinal and paleoenvironmental setting of late Ediacaran taphonomic windows in the southwest USA: *in preparation*.
- Selly, T.*, **Smith, E.F.**, Nelson, L.L.*, Thater, C.A., Schiffbauer, J.D. Taxonomy of the Terminal Ediacaran vermiform biota, Wood Canyon and Deep Spring Formations, Nevada: *in preparation*.

Conference Proceedings that have resulted from this work (student author indicated with *)

- Smith, E.F.**, Nelson, L.L.*, Fossils and strange abiotic structures at the Ediacaran-Cambrian Boundary in the Southwest USA, Gordon Geobiology Conference, Galveston TX, January 2018 (*invited*).
- Smith, E.F.**, Nelson, L.L.*, The basinal and paleoenvironmental setting of late Ediacaran taphonomic windows in the southwest USA. GSA Annual Meeting, Seattle WA, September 2017.
- Selly, T.*, **Smith, E.F.**, Nelson, L.L.*, Thater, C.A., Schiffbauer, J.D., Taxonomy of the Terminal Ediacaran vermiform biota, Wood Canyon and Deep Spring Formations, Nevada. GSA Annual Meeting, Seattle WA, September 2017.
- Smith, E.F.**, Nelson, L.L.*, The Precambrian-Cambrian Boundary in the Southwest USA. International Symposium on the Ediacaran-Cambrian Transition, St. John's, Newfoundland, June 2017.
- Smith, E.F.**, Nelson, L.L.*, Calibrating the Precambrian-Cambrian Boundary globally: Insights from the Southwest USA. Geobiology Society Conference, Banff, Canada, June 2017 (*invited*).

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Smith, E.F., Nelson, L.L.*, Tweedt, S.M., O’Connell, N.*, A link between latest Ediacaran assemblages globally: New fossil finds from the lower Member of the Wood Canyon Formation in Death Valley. GSA Annual Meeting, Denver CO, September 2016.

Invited departmental seminars on the Ediacara biota in the Southwest USA

2018: Caltech (upcoming), Carnegie DTM (upcoming)

2017: Smith College, Princeton University, Virginia Tech Departmental Seminar, University of Texas at Austin Paleontology Seminar

Supplemental Maps and Photographs



Caption: Emmy Smith with the Ediacaran-Cambrian Boundary section at Mt. Dunfee in the backdrop.



Caption: Students Nizhoni O’Connell and Lyle Nelson taking a break to take some notes and eat snacks.

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Caption: One of Gold Point's ghost town cabins ~1 km away from the section at Mt. Dunfee



Caption: A satellite image showing the two study sites in Nevada that have yielded exceptionally-preserved Ediacaran body fossils.